BSC

Model Administrative Change Notice

Complete only applicable items.

1. Document Number:	MDL-MGR-GS-000002	2. Revision:	02	3. ACN:	01
4. Title:	Atmospheric Dispersal and Deposition of Tephra from a Potential Volcanic Eruption at Yucca Mountain, Nevada				
5. No. of Pages Attached	4				

6. Approvals:

	Print name and sign	Date
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7. Affected Pages	8. Description of Change:
6-42, 6-44, 6-46, and 6-48	Editorial Correction, citation update Replace source data DTN designator, change: DTN: LA0507CH931611.001 [DIRS 174843] To ***DTN: LA0507CH831611.001 [DIRS 174843]*** Note: This change needs to be made to make the affected pages consistent with the correct references to that DTN in the rest of the document and in DIRS. This change was self-identified.

6.7.2 Ash Redistribution Model Abstraction

6.7.2.1 Model Description

The ash redistribution model describes the range of conditions that allows for the transport of contaminated ash to the RMEI location by sedimentary processes. The model implicitly includes both alluvial and eolian transport processes as well as sediment transport mechanisms that could concentrate radionuclides, such as placer deposition along the channel, at the RMEI location.

If a volcano were to intersect the repository, the eruption would most likely result in waste-contaminated tephra being dispersed in the northeasterly direction as determined by the prevailing wind during a future eruption (Section 5.2.1), but primary deposition of contaminated waste at the RMEI location could also occur (Figure 6-1). Tephra that originally did not fall at the RMEI location could be redistributed to the RMEI location by sedimentary processes.

6.7.2.2 Formulation

Field studies of tephra dilution in drainages around the Lathrop Wells cone and of surficial erosion/deposition rates based on ^{137}Cs, along with general considerations of the sediment transport systems around Yucca Mountain, suggest a simple model for TSPA. This model and its output parameters for use in TSPA are summarized in Table 6-5 in terms of the two tephra fall/redistribution outcomes described in Section 6.6.1, as well as the two main geomorphic features at the RMEI location (interchannel divides and distributary channels). In Outcome 1, the primary tephra sheet is deposited at the location of the RMEI. In Outcome 2 the tephra sheet is deposited within the Fortymile Wash drainage basin (consistent with prevailing southwestern winds) at some distance upstream from the RMEI location. For the purposes of TSPA, the distinction between Outcomes 1 and 2 should be made on the basis of the presence of non-negligible thickness of ash at the RMEI location. Non-negligible ash thickness should be defined as greater than or equal to the smallest mean ash particle diameter of 0.001 cm. This thickness, or greater, of ash constitutes ash fall at the RMEI location (Outcome 1); less than 0.001 cm constitutes Outcome 2. Model Outcomes 1 and 2 represent the maximum availability of waste-contaminated ash at the RMEI location. Other tephra-sheet orientations either eliminate ash from reaching the RMEI location, or reduce the available volume of ash to be redistributed to the RMEI location.

6.7.2.3 Interchannel-Divide Areas

The interchannel divides are the broad, nearly flat surfaces of the fan that separate active channels. Interchannel divides comprise 82 percent of the Fortymile Wash alluvial fan (DTN: LA0507CH831611.001 [DIRS 174843]).

Outcome 1–For igneous eruptive events that produce an initial ash fall at the RMEI location (Table 6-5), the initial tephra thickness is provided by TSPA Ashplume results. An ash and soil removal factor ranging from 0.02 cm/yr to 0.04 cm/yr (DTN: LA0407DK831811.001 [DIRS 170768]) is applied so that removal of 10 cm tephra or soil by erosion would occur in 250 to 500 years.

Table 6-5. Ash Redistribution Model Abstraction for the TSPA-LA Model (Continued)

	Interchannel Divide	Distributary Channels
Areal Weight	**0.82**	**0.18**
Outcome 2 No primary tephra fall on or near the RMEI location. Primary tephra deposition in upper Fortymile Wash drainage basin.	Possible contamination by eolian processes or major flood events is approximated by a 1 to 2 cm (uniform distribution) layer. 1/100th of the initial Mean Primary Waste Concentration (see Table 6-4) is assumed to remain indefinitely.	**Initial condition** Initial ash-layer thickness: uniform distribution from 1 to 15 cm. Initial waste concentration: Mean Primary Waste Concentration (see Table 6-4). **Ash removal** Volumetric concentration of waste in the ash layer decreases linearly from its initial volumetric concentration to 1/100th of its initial volumetric concentration within a time period uniformly distributed between 100 and 1,000 years. This decrease in volumetric concentration represents dilution during removal and replacement of the initial sediment. **Residual conditions** After removal of the initial volumetric concentration, a layer with the same initial thickness but with 1/100th of the initial volumetric concentration is assumed to remain indefinitely. This residual layer represents lower levels of contamination that may be brought down the wash or exposed from underlying soil.

Source: Output DTN: LA0408CH831811.001.

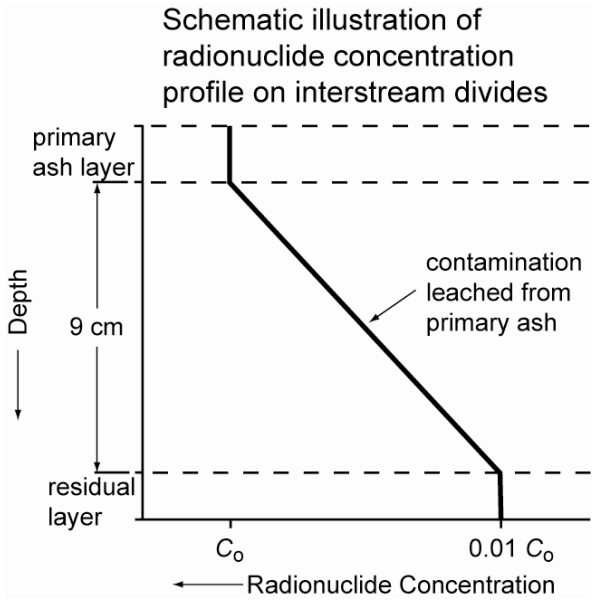
NOTES: 1. The uniform distribution of erosion rate of 0.02 cm/yr to 0.04 cm/yr (DTN: LA0407DK831811.001 [DIRS 170768]) is based on current climate conditions. Although there is considerable uncertainty associated with long-term (10,000 yr) erosion rates, the range provided is considered reasonable for the parts of the regulatory time frame when conditions are essentially as they are today. Major changes in precipitation, or storm type may result in significant changes in erosion rates on these alluvial surfaces.

2. Areal weights are developed in DTN: LA0507CH831611.001 [DIRS 174843].

3. Volumetric waste concentrations specified in this table should be derived from the Mean Primary Waste Concentration calculated at 18 km, at the midpoint of the plume, as reported in Table 6-4, and from the mean ash layer thickness at the same location, which is also based on the results in Table 6-4. A value of 1.0 g/cm^3 should be used for ash settled density (DTN: LA0407DK831811.001 [DIRS 170768]). For example, ash areal concentration (g/cm^2) divided by ash settled density (g/cm^3) equals ash thickness (cm); waste areal concentration (g/cm^2) divided by ash (or deposit) thickness (cm) equals waste volumetric concentration (g/cm^3). The resulting volumetric concentration should then be applied to the layer thicknesses (e.g., 1 to 15 cm uniformly distributed or 1 cm to 2 cm uniformly distributed) in this table.

The technical basis for the ash removal rate distribution is a ^{137}Cs study and interpretation of this data yields an estimate of erosion of 1 cm to 2 cm of the upper soil horizon in interchannel divide areas over a 50-year period. The uniform distribution of erosion rates of 0.02 cm/yr to 0.04 cm/yr is based on current climate conditions (Section 5.1.4).

The concentration of waste in ash is represented by a contaminated soil layer 9-cm thick (Figure 6-5), in which radionuclide concentration within the layer decreases linearly from the value initially in the ash to 1 percent of that value at 9-cm depth (Table 6-5). The linear concentration decrease is conservative with respect to the exponential decrease observed in ^{137}Cs studies (BSC 2004 [DIRS 169980], Section 6.3.4.2; DTN: LA0308CH831811.002



Source: BSC 2004 [DIRS 169980], Section 6.3.4.2.

NOTE: For illustration purposes only.

Figure 6-5. Schematic of Decrease in Radionuclide Concentration in Soil

6.7.2.4 Distributary Channels

Distributary channels are the parts of an alluvial fan that act as active drainages during runoff events. Distributary channels compose 18 percent of the Fortymile Wash alluvial fan (DTN: LA0507CH831611.001 [DIRS 174843]).

Outcome 1–Processes are likely to be more complex in the distributary channels because tephra can be washed in from upstream areas during storm events. Redistributed sediment is in transient storage, and redistributed tephra thicknesses are variable with time within distributary channels. Although dilution (mixing) is likely to occur, it is conservatively assumed that the initial washed-in tephra is not mixed but is deposited in channels at the RMEI location in layers ranging from 1-cm to 15-cm thick. The upper value for this range was chosen on the basis of channel depths; sediment greater than 15-cm thick would likely overtop the channel margins in this area of the alluvial fan.

The initial conditions in the distributary channels account for the rapid transport of contaminated ash in channels near the RMEI location in the first few years after the eruption. In addition, the initial conditions account for the possibility of a hybrid model outcome in which significant ash is deposited at both the RMEI location and in the near portions of Fortymile Wash and rapid transport within the wash results in enhanced thicknesses of ash in the distributary channels at the RMEI location. The initial thickness is determined as the greater of two values:

- A 1-cm to 15-cm thick layer sampled from a uniform distribution
- The initial ash layer thickness calculated for the interchannel divide areas.

6.7.2.5.1 Areal Weights for Channels and Interchannel Divides

Type: point values
Value: 0.18, 0.82
Units: N/A

The relative area factors (areal weights) for distributary channels and interchannel divides are used in TSPA-LA to combine the processes occurring on the two different landforms within the ash redistribution model (Table 6-5). The relative area covered by distributary channels on the upper portion of the Fortymile Wash alluvial fan is 0.18, while the relative area covered by interchannel divides is 0.82 (DTN: LA0507CH831611.001 [DIRS 174843]). These values were developed by the use of a planimeter (Figure 6-2).

6.7.2.5.2 Ash erosion Rate from Interchannel Divide Areas

Type: uniform distribution
Value: 0.02-0.04
Units: cm/yr

The ash erosion rate is defined as the range (0.02 cm/yr to 0.04 cm/yr) for the removal of ash from interchannel divide areas in the Yucca Mountain region. The ash erosion rate is based on ^{137}Cs concentrations in samples collected from the Yucca Mountain region (BSC 2004 [DIRS 169980], Section 6.3.4). This rate is consistent with regional and statewide erosion for cultivated and non-cultivated farmland (BSC 2004 [DIRS 169980], Section 6.3.4.2.5).

6.7.2.5.3 Residual Concentration Factor for Waste In soil

Type: point value
Value: 0.01
Units: N/A

The concentration of waste in the ash layer decreases linearly from its initial concentration to 1 percent of its initial concentration within a time period uniformly distributed between 100 years and 1,000 years. This decrease in concentration represents dilution during removal and replacement of the initial sediment. The assumed decrease in waste concentration in ash is consistent with the decrease in ^{137}Cs concentrations in soil from the surface to depths of about 9 cm. ^{137}Cs concentrations decrease rapidly with depth and reach non-detectable levels at 9 cm or less (BSC 2004 [DIRS 169980], Section 6.3.4.2; DTN: LA0308CH831811.002 [DIRS 164853]). No ^{137}Cs has been detected below about 9 cm apparently because of the occurrence of a carbonate-rich layer that impedes infiltration of ^{137}Cs. Based on the apparent analogy between waste concentration in ash-laden sediments and ^{137}Cs concentration in soil, the use of a residual waste concentration in ash is reasonable and perhaps conservative.